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ORIGINAL PAPER

How autonomy-supportive learning environments promote Asian international students' academic adjustment: a self-determination theory perspective

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Abstract
We explored Asian international students' successful learning experiences and adjustment through the lens of self-determination theory. To explore how international students perceive their classroom learning environments and learning experiences in more detail, a sequential explanatory mixed-methods approach was used. In the quantitative phase, empirical relationships between autonomy-supportive environments and affective (language anxiety), behavioral (discussion participation), and cognitive (adaptive beliefs about classroom assessments) learning components in the classroom were examined. In the qualitative phase, results from the quantitative study were further explored for additional explanations through follow-up interviews. Autonomy-supportive environments seemed to satisfy international students' basic psychological needs, which decreased language anxiety and increased classroom participation and adaptive perspectives about classroom assessments. The discussion focuses on the theoretical and classroom implications of the quantitative and qualitative findings. This study contributes to the literature by suggesting a solid theoretical foundation to support successful academic adjustment among Asian international students.

Keywords Adjustment · Asian international students · Learning environment · Mixed-methods · Self-determination theory

Introduction

The international student body constitutes a large part of US higher education, contributing to internationalization and diversity and bringing cultural and economic benefits to US college culture (Mamiseishvili, 2012; Wu et al., 2015). This student body has been drastically increasing and has become an important population in higher education (Ecochard

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& Fotheringham, 2017). As many international student populations grow, there has been growing interest in these students' successful adaptation to US universities. When international students come to the USA to study, they often face an unfamiliar social and educational culture (Olivas & Li, 2006) and academic and psychological challenges such as English language barriers, a lack of knowledge about the host culture, limited relationships with advisors and professors, a lack of familiarity with teaching and curriculum differences, isolation, and anxiety (Andrade, 2006; Parks & Raymond, 2004; Poyrazli & Grahame, 2007). Asian international students, in particular, face more-challenging adjustment issues than Western international students (Abe et al., 1998; Rienties et al., 2012) because they are less integrated and face more academic and social obstacles because of language and cultural barriers to integration into US academic life (Leong, 2015; Rienties et al., 2012). Previous research has highlighted international students' adjustment by focusing on their stressors and coping strategies during their transition to English-speaking countries (Misra et al., 2003; Zhang & Goodson, 2011). As a result, most studies have taken place within counseling psychology, focusing on students' stressors and psychological issues (Lee et al., 2004; Misra et al., 2003; Poyrazli et al., 2004; Zhang & Goodson, 2011), but researchers have paid little attention to the aspects of international students' perceptions of academic environments at the classroom level to explain successful academic adjustment.

Within the context of international students' successful transition to US campuses, their academic success and adjustment have been less of a focus in the recent work. International students' academic integration and factors that affect their academic performance should be an object of focus (Rienties et al., 2012). Moreover, the literature could benefit from a comprehensive theoretical framework from motivational perspectives to explain international students' successful academic transition to higher education.

Guided by self-determination theory (SDT; Deci & Ryan, 2002)—which is a humanistic theory that has been researched for the past 40 years—we argue that SDT can provide a comprehensive theoretical framework to explain international students' successful classroom learning experiences regarding communication and adjustment. We focused on the experiences of Asian international students who could possess unique needs and encounter academic challenges. The purpose of this study was to explore how classroom learning environments can promote international students' academic adjustment by supporting adaptive learning behaviors. In the quantitative phase, we investigated the empirical relationships between autonomy-supportive environments and affective (language anxiety), behavioral (discussion participation), and cognitive (adaptive beliefs about classroom assessments) learning components in the classroom. To confirm the findings from the quantitative data, we qualitatively explored how international students perceived an autonomy-supportive learning environment in the US universities.

International students' challenges in academic adjustment

Linguistic challenges

Academic adjustment refers to the degree to which a student can successfully cope with various educational tasks and assignments, and take the initiative to achieve academic goals in foreign academic contexts (Baker & Siryk, 1999). Such academic integration is found to be a crucial predictor of academic performance for international students (Rienties et al., 2012). Asian international students, most of whom are non-native English speakers,

often encounter distinctive academic barriers and challenges in English-speaking countries compared with Western international students. Asian students have a different conception of learning as compared to western students (Zhu et al., 2008). Research has identified that international students have unique needs and challenges that may affect their academic performance, adjustment, and well-being (Andrade, 2006; Ecochard & Fotheringham, 2017; MacGregor & Folinazzo, 2018). English proficiency and communication styles with faculty are significantly related to students' academic adjustment because these factors affect students' academic achievement (Anaya, & Cole, 2001; Li et al., 2010).

Language skills are closely related to students' social and academic performance (Chen, 1999; Olivas & Li, 2006). Listening skills to understand lectures and academic conservations, reading skills, speaking skills for oral communication, and writing skills including note-taking and writing essays are critical for adjustment (Lee, 1997; Lewthwaite, 1996; Senyshyn et al., 2000). On the other hand, language barriers can represent challenging issues for academic adjustment (Chen, 1999). International students who are non-native speakers of English were found to encounter difficulties in understanding professors' accents and idiomatic styles, in taking notes quickly in English, and in participating in group work (Holmes, 2004; Poyrazli & Grahame, 2007). Students' inadequacy in English prevents their engagement in classroom activities (Lewthwaite, 1996; Robertson et al., 2000). Language anxiety and lack of confidence can inhibit their classroom participation and hinder relationships with faculty and peers (Andrade, 2006; Parks & Raymond, 2004; Poyrazli & Grahame, 2007; Robertson et al., 2000). Moreover, a lack of strategic discussion skills and adequate listening comprehension skills made international students participate less and have more difficulty in communicating with team members, which can affect academic performance (Holmes, 2004; Poyrazli & Grahame, 2007).

Cultural influences on students' learning

Cultural backgrounds can have a huge impact on students' learning. Although students might not be aware of it, culture is still crucial in students' behaviors, values, thoughts, and feelings at different levels. The cultural effect provides a crucial perspective on international students' academic adjustment because their cultural backgrounds have an association with students' learning styles, communication styles, and use of different learning strategies (Altugan, 2015; Auyeung & Sands, 1996; Dhindsa & Abdul-Latif, 2012; Lee et al., 2017; Park, 2001; Zhu et al., 2008). Students' perceptions of learning environments differ among various ethnic groups (Singh & McNeil, 2014). Students' diverse cultural backgrounds often contribute to diversity in the learning environment but also interfere with their own learning process (Burgess et al., 2009; Hodkinson & Poropat, 2014). Different cultures have different interpretations of the concepts of competition, achievement, and academic misbehavior (such as cheating or plagiarism) (McMillan, 2017). These cultural differences sometimes influence classroom communication with peers or instructors from different cultural backgrounds (Dhindsa & Abdul-Latif, 2012). Communication styles and a lack of multicultural learning content can influence international students' academic adjustment (Liu et al., 2010). Moreover, student success can be interpreted through different lenses of cultural background (Dhindsa & Abdul-Latif, 2012; Hodkinson & Poropat, 2014). Instructional design, such as problem-solving learning or cooperative learning, and textbooks including culturally-sensitive understanding can promote students' cultural understanding (Busse & Krause, 2015; Rienties et al., 2012; Zarei, 2011). However, these implementations do not always succeed in improving students' awareness of intercultural mindset (Beagan, 2003). To maintain a

positive approach to intercultural mindset, long-term projects are needed (Busse & Krause, 2015). Furthermore, instructors should be aware of how students' cultural backgrounds play an underlying role in their learning (Hodkinson & Poropat, 2014).

Because there are differences between Asian countries and American learning environments, there are different expectations about students' participation and academic success. For example, there are more dialogical discussion environments in the USA (Holmes, 2004), with students' unfamiliarity with the dialogic characteristics of US classroom environments interfering with students' academic performance (Robertson et al., 2000). Besides, international students' motivation to learn, use of adaptive learning approaches, self-regulation, and anxiety in missing out can affect their academic adjustment (Andrade, 2006; Hodkinson & Poropat, 2014; Martirosyan et al., 2015; Phakiti et al., 2013; Poyrazli et al., 2002). Instructors might need to understand the underlying reasons for international students' challenges and mindsets during their instructional practice (Hodkinson& Poropat, 2014).

Assessment practices

Assessment is crucial for estimating the level of knowledge of students and enhancing instructional practices and students' learning (Shepard, 2000). Assessment has various purposes and functions. It can be categorized as formative or summative. Formative assessments focus on providing feedback on students' performance during instruction, whereas summative assessments evaluate students' mastery of knowledge at the end of a certain term (McMillan, 2017). Formative assessments are used to give feedback to students for their improvement, whereas summative assessments are used to provide evidence of achievement for skills and knowledge (Segers & Dochy, 2006). Assessments can involve standardized tests, such as large-scale high-stakes tests, and course-based assessments for assessing students' achievement and informing instructors and students about students' actual performance in classroom activities. Finally, assessment can be categorized into criterion-referenced and norm-referenced assessment. Criterion-referenced assessments give students achievement information on specific tasks, whereas the norm-referenced assessment involves comparing an individual's performance to others and placing him/her in rank order as with standardized tests such as the Scholastic Aptitude Test (SAT). Because assessment contains various functions in diverse classroom settings, instructors should take such purposes into consideration to improve student learning (Segers & Dochy, 2006).

Other crucial considerations are the cultural and linguistic differences that can affect students' performance in assessment (McMillan, 2017). The knowledge that is culturally embedded but not explicitly taught can impede international students' assessment performance (McMillan, 2017). To remove cultural barriers, including language or content, and to ensure an accurate evaluation of what students know and achieve, it is important to address these barriers to performance in assessment (Liu et al., 2010; McMillan, 2017). Multiple and inclusive assessment practices are recommended for evaluating students' understanding (Cuseo, 2015; Kaur et al, 2017; McMillan, 2017; Nortvedt et al., 2020).

International college students can experience various classroom assessments and assignment tasks that could be unfamiliar types, which might confuse students because of their unfamiliarity with the assessment technique, grading, question choice, and language (De Vita, 2002; Heng, 2018). Higher education in the USA uses different types of formative and summative assessments, such as online assessments, group projects, research papers, team projects, laboratory assignments, and self- and peer assessments, in addition to multiple-choice examinations (Boud, 2000; Dochy et al., 1999). Because of their unfamiliarity

with these higher education assessments, international students can have difficulty handling academic demands. Depending on their disciplines, students need to learn how to participate in laboratory projects or write reflections or research papers. Their perspectives and attitudes toward the course assessments could contribute to improving the learning experience, which in turn promotes academic adjustment. Previous research supports this assertion (e.g., Cho et al., 2020). If students hold adaptive beliefs about assessments, they are more likely to perceive them as fair, authentic, helpful, and consistent with learning objectives, with these adaptive perceptions of assessment being linked to desirable learning outcomes, such as higher achievement and self-regulated strategies (Brown, 2011; Brown et al., 2009; Cho et al., 2020). It is presumable that if international students perceive classroom assessment as useful and meaningful learning experiences in their courses, they could be more likely to integrate themselves into US academic environments.

Self-determination theory as a theoretical framework

Basic psychological needs

Self-determination theory (SDT; Deci & Ryan, 2002), which suggests that satisfaction of basic psychological needs fosters positive functioning and well-being, could provide theoretical groundwork for explaining international students' adjustment from motivational perspectives. SDT suggests that motivated behaviors differ with the extent to which individuals are autonomous versus controlled (Black & Deci, 2000). Within SDT, basic psychological needs theory defines needs as the nutrients that must be satisfied by a living entity to sustain its growth, integrity, and physiological or psychological health (Black & Deci, 2000). Ryan and Deci (2000) propose that autonomy, competence, and relatedness are psychological needs that, when satisfied, lead to positive outcomes and well-being in highly-functioning individuals. *Autonomy* is the need to experience one's behavior as integrated within the self or by the self (Ryan & Deci, 2017). When individuals are autonomous, they perceive their behaviors and actions with a high degree of willingness and a sense of choice (Deci & Ryan, 1985; Reeve et al., 2003). *Competence* is the need to feel effective in one's capability to achieve intended outcomes in the environment (Ryan & Deci, 2017). When individuals are competent, they search for optimal challenges and extend their skills (Deci & Ryan, 1991, 2002). *Relatedness* is the need to create close and secure attachments with others. When individuals feel relatedness, they feel emotionally connected to and involved in caring and supportive relationships (Deci & Ryan, 1991, 2002). SDT proposes that these needs must be satisfied before individuals experience optimal psychological development, growth, performance, integrity, and well-being within any domain and across cultural contexts (Jang et al., 2009; Ryan & Deci, 2000, 2008). When any one of the three basic psychological needs (autonomy, competence, and relatedness) is unsatisfied or neglected in a domain, individuals show a motivational and psychological decline, including decreased vitality, willingness, integration, and well-being (Ryan & La Guardia, 2000). The concept of basic psychological needs provides a richer understanding of what people need for optimal living (Ryan & Deci, 2008).

A growing body of literature supports the theoretical assertion that experiencing the satisfaction of these needs is crucial to the experience of growth, integrity, and well-being (Ryan & Deci, 2017). In empirical research, the satisfaction of these needs during learning activities has consistently been associated with students' positive and productive learning

experiences (Ryan & Deci, 2000), including academic motivation, strong self-concept, intrinsic motivation, positive sense of self, and subjective well-being (Faye & Sharpe, 2008; Levesque et al., 2004). Although there can be cultural divergence in how these needs are supported and satisfied, the need for autonomy, competence, and relatedness is considered cross-culturally universal in promoting positive functioning and learning-related experiences (Chen et al., 2015; Levesque et al., 2004; Ryan & Deci, 2000). Therefore, our hypothesis is that basic psychological needs theory can provide a theoretical context to explain international students' successful academic adjustment.

Autonomy-supportive learning environments

Basic needs theory proposes that sociocultural conditions such as classroom environments can support and cultivate students' basic psychological needs (autonomy support) or thwart these needs (external control) (Ryan & Deci, 2017). That is, environments supporting the individual's autonomy enrich the satisfaction of all three needs and, in turn, bring about self-determined behaviors, including intrinsic motivation, which is the prototype of self-determination. In contrast, environments that fail to meet these needs foster the development of non-self-determined behaviors such as promoting extrinsic motivation by external factors, academic indifference or amotivating behaviors, including extrinsic motivation (Faye & Sharpe, 2008). Autonomy support is a mutual behavior whereby one person promotes another person's intentions and psychological needs (Reeve & Jang, 2006). When a person with authority takes another individual's perspective, acknowledges the individual's feelings, and offers him or her an opportunity for choice in solving a task in his or her own way, the person with authority creates an environment that is conducive to autonomy support (Deci & Ryan, 1985; Reeve, 2006; Reeve & Jang, 2006). Such an environment supports and promotes individuals' self-determination of classroom activities and can help to satisfy their basic psychological needs (Deci & Ryan, 2016).

In an education setting, autonomy-supportive instruction satisfies students' needs for autonomy, competence, and relatedness and enhances students' autonomous motivation and learning behaviors related to classroom academic performance and engagement (Reeve, 2006; Ryan & Deci, 2000). An autonomy-supportive instructor designs a classroom environment favorable to satisfying students' basic needs and attempts to support their inner motivation so that they can feel more respected, acknowledged, and accountable in the learning environment (Deci & Ryan, 2016; Reeve, 2006, 2009). For example, when instructors introduce classroom tasks, they are more likely to employ informational and non-controlling language, try to share the value of tasks, and provide informative feedback to support students' progress and learning mastery (Conklin, 2013; Reeve, 2006, 2009). Moreover, they present more empathy by trying to put themselves in their students' shoes and by identifying potential difficulties for students, thus contributing to students' internalization process and eventually building up their intrinsic motivation (Reeve, 2009; Reeve & Jang, 2006).

Several studies have supported the theoretical hypothesis that students' perceptions of teachers' autonomy support are positively associated with the satisfaction of students' psychological needs for autonomy, competence, and relatedness, which in turn promotes positive academic outcomes (Deci, Koestner, et al., 2001; Deci, Ryan, et al., 2001; Jang et al., 2009; Vallerand et al., 1997). An extensive body of literature shows that autonomy-supportive learning environments are linked to positive learning experiences: more intrinsic motivation (Leroy et al., 2007), adjustments and increases in perceived competence

and enjoyment (Chirkov et al., 2003), higher achievement (Boggiano et al., 1993), greater academic success (Boggiano et al., 1993), more perceived autonomy, greater involvement, more persistence, and greater psychological well-being (Leroy et al., 2007; Reeve & Jang, 2006), better self-regulation (Jang et al., 2009), and decreased anxiety (Black & Deci, 2000). Therefore, autonomy-supportive environments are expected to contribute to international students' classroom participation and adaptive beliefs about assessment, which eventually promote successful academic adjustment.

Present study

Based on previous literature, it is assumed that learning environments that support students' desirable affective, behavioral, and cognitive learning behaviors help them with academic adjustment in the classroom. Thus, we investigated how students' perceptions of autonomy-supportive environments and satisfaction of basic psychological needs have an impact students' affective (language anxiety), behavioral (discussion participation), and cognitive (adaptive beliefs about classroom assessments) learning components. This study was guided by the following two research questions:

1. Do autonomy-supportive environments and the satisfaction of basic psychological needs promote Asian international students' desirable affective, behavioral, and cognitive learning components? (Quantitative Phase)

    H1. Autonomy-supportive environments and satisfaction of basic psychological needs decrease students' language anxiety and increase classroom discussion participation and adaptive beliefs about assessment.
    H2. Asian international students' language anxiety is negatively associated with discussion participation.

2. How do Asian international students perceive an autonomy-supportive learning environment? (Qualitative Phase)

Methods

The present study used an explanatory sequential mixed-method design to provide an extra dimension of understanding of students' academic adjustment and perception of an autonomy-supportive environment, which enabled us to examine both quantitative and qualitative aspects of the topic (Creswell & Piano Clark, 2007). To investigate how learning environments affect students' learning behaviors, we began with an analysis of quantitative data to provide a broad picture of the research questions, followed by the subsequent analysis of qualitative data to provide insights into the quantitative findings (Creswell & Piano Clark, 2007). This study received institutional review board approval.

Quantitative phase (RQ 1)

In the quantitative phase, preliminary analyses provided descriptive statistics, correlations, and reliabilities of the measures. Then, structural equation modeling (SEM) was used to investigate relationships between the proposed variables.

Participants

The participants were 356 Asian undergraduate students who were enrolled as a full-time international students at a large Midwestern university in the USA and volunteered to participate in the online survey. They were mostly from China, Korea, Japan, and Southeast Asian countries. Approximately 28.1% of the participants were freshmen, 27.0% were sophomores, 25.0% were juniors, and 19.9% were seniors. Participants were 51.7% female and 48.3% male. Approximately 42.1% of the participants were engineering and technology majors, 13.5% were liberal arts majors, 21.9% were science- and mathematics-related majors, 14.6% were business-related majors, and 7.9% were other majors. Additionally, approximately 19% of the participants had stayed in the USA or in an English-speaking country for less than 1 year, 22.7% for 1–2 years, 18.1% for 2–3 years, 18.1% for 3–5 years, and 22.1% for more than 5 years.

Measures

The *Learning Climate Questionnaire (LCQ)* of Williams and Deci (1996) was used to assess students' learning climates. Sample items are "I feel that my instructor provides me choices and options" and "My instructor conveyed confidence in my ability to do well in the course". Cronbach's α reliability for the scale was 0.92 in the current study.

The *Basic Psychological Needs Scale (BPNS)* (Deci & Ryan, 2000; Gagné, 2003) allows participants to indicate their need satisfaction (autonomy, competence, and relatedness) in their course. The questionnaire consists of 21 items (7 items per construct). Cronbach's α reliability for autonomy, competence, and relatedness in the current study was 0.79, 0.79, and 0.75, respectively.

From the *Foreign Language Classroom Anxiety Scale (FLCAS)* (Horwitz et al., 1986), eight items were selected and revised according to the domain-specific context to assess language anxiety for international students within different disciplines and majors. A sample item is "I start to panic when I have to speak English without preparation in advance in class." Cronbach's α reliability for the scale in the current study was 0.81.

The *Classroom Participation Survey* (Meyer, 2009) measured students' participation in whole-classroom and small-group discussion with 10 relevant items from the *Global Engagement Style Frequency* and *Global Engagement Style Preference* subscales. Cronbach's α reliability for this scale in the current study was 0.89.

The *Beliefs about Assessment Scale (BAS)* (Cho et al., 2020) consists of 26 items for assessing students' beliefs about assessment with the four subscales of Benefit for Learning, Authenticity, Consistency with Learning Objectives, and Fairness. This scale was generated based on the findings of semi-structured interviews conducted with international undergraduates and two existing instruments, SCoA-VI (Brown, 2011) and PATI (Dorman & Knightley, 2006). Cronbach's α reliability for the four factors in the current study were 0.92, 0.88, 0.83, and 0.84, respectively.

Procedures

A total of 356 Asian international students participated in the online questionnaires that included all scales. In introducing the survey, participants were instructed to choose one class among their major courses that they were currently taking that semester and that they perceived as being their most important class. Then, they were asked to answer all questions in reference to that class. In this way, participants were able to respond to all items regarding their classroom experiences.

To examine relationships between learning climates and other variables, structural equation modeling (SEM) was used to test the theoretical fit of the hypothesized model guided by SDT (see Fig. 1). Based on the nature and dimensionality of items, we used parcels of items as variables in SEM procedures (Little et al., 2002).

Results for RQ1

Table 1 shows descriptive statistics and correlations among all variables included in the hypothesized model. Bivariate Pearson correlation analysis revealed that an autonomy-supportive learning climate was correlated with all three basic psychological needs, participation, and adaptive beliefs about assessment variables except for language anxiety. The needs for autonomy, competence, and relatedness were positively correlated with discussion participation and adaptive beliefs about assessment, whereas the need for competence was negatively correlated with language anxiety. The more that students feel competent in their learning practices in the classroom, the less they feel language anxiety. As we anticipated, students' language anxiety was negatively correlated with discussion participation and adaptive beliefs about assessment, indicating benefit for learning, consistency, and fairness of assessment.

To investigate how learning climate and satisfaction of psychological needs are related to language anxiety, discussion participation, and adaptive beliefs about assessment, a follow-up structural equation model was tested. To assess hypothesized model fit, the following goodness-of-fit estimators were investigated: the χ^2 statistic, the comparative fit index (CFI; Bentler, 2007), the non-normed fit index (NNFI), which is also known as the

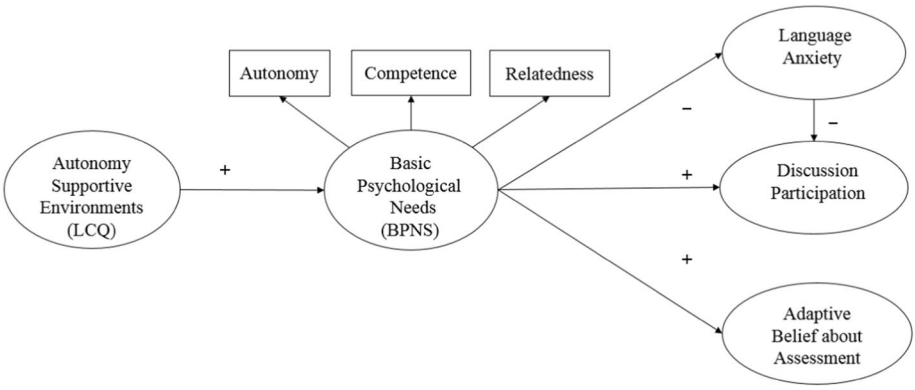

Fig. 1 Hypothesized structural model

Table 1 Descriptive statistics and correlation coefficients among variables ($N = 356$)

Variable	*M*	SD	Maximum	Correlations									
				1	2	3	4	5	6	7	8	9	10
1. Learning Climate	5.17	1.20	7.00	1.00									
2. Autonomy	5.16	1.19	7.00	.80**	1.00								
3. Competence	5.03	1.21	7.00	.69**	.77**	1.00							
4. Relatedness	4.90	1.20	7.00	.63**	.67**	.68**	1.00						
5. Anxiety	2.62	.95	5.00	− .08	− .09	− .12*	− .09	1.00					
6. Participation	2.92	.78	5.00	.18**	.23**	.30**	.35**	− .49**	1.00				
7. Benefit for Learning	3.88	.68	5.00	.51**	.50**	.53**	.45**	− .16**	.23**	1.00			
8. Authenticity	3.62	.82	5.00	.40**	.41**	.46**	.36**	− .09	.23**	.68**	1.00		
9. Consistency	4.00	.79	5.00	.37**	.33**	.38**	.27**	− .20**	.17**	.69**	.46**	1.00	
10. Fairness	3.79	.80	5.00	.43**	.46**	.51**	.37**	− .14**	.19**	.78**	.72**	.66**	1.00

*Significant at the $\alpha = .05$ level (two-tailed), ** Significant at the $\alpha = .01$ level (two-tailed). Basic psychological needs refer to autonomy, competence, and relatedness. Adaptive beliefs about assessment refer to benefit for learning, authenticity, consistency, and fairness

Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA; Steiger & Lind, 1980), and the standardized root mean square residual (SRMR; Bentler, 2007). In general, a model with CFI and TLI values greater than 0.90, SRMR values less than 0.10, and RMSEA values between 0.05 and 0.08 indicate acceptable fit (Kline, 2005).

The data fitted the hypothesized model well: ($\chi 2(147)=464.44$, $p<0.001$; CFI = 0.93; TLI = 0.92; SRMR = 0.06; RMSEA = 0.08). The full SEM model with results is shown in Fig. 2. Students' perception of autonomy-supportive environments (LCQ) was found to be significantly associated with students' basic psychological needs (BPNS) ($\beta=0.88$, $p<0.001$). BPNS was significantly and negatively related to language anxiety ($\beta=-0.11$, $p=0.049$) and significantly and positively associated with discussion participation ($\beta=0.26$, $p<0.001$) and adaptive beliefs about assessment ($\beta=0.61$, $p<0.001$). Additionally, language anxiety was significantly and negatively associated with students' classroom discussion participation ($\beta=-0.53$, $p<0.001$).

Based on these results, we concluded that Asian international students' perception of autonomy-supportive environments was significantly associated with satisfaction of their autonomy, competence, and relatedness needs, as initially proposed. Hypothesis 1, which stated that satisfaction of basic psychological needs has a direct positive effect on decreasing language anxiety and increasing classroom participation and adaptive beliefs about assessment, was supported. In addition, Hypothesis 2, which stated that language anxiety has a direct negative association with students' willingness to participate in discussions, was supported.

Discussion for quantitative phase

In the quantitative phase, we examined the relationships between international students' perception of autonomy-supportive environments, language anxiety, discussion

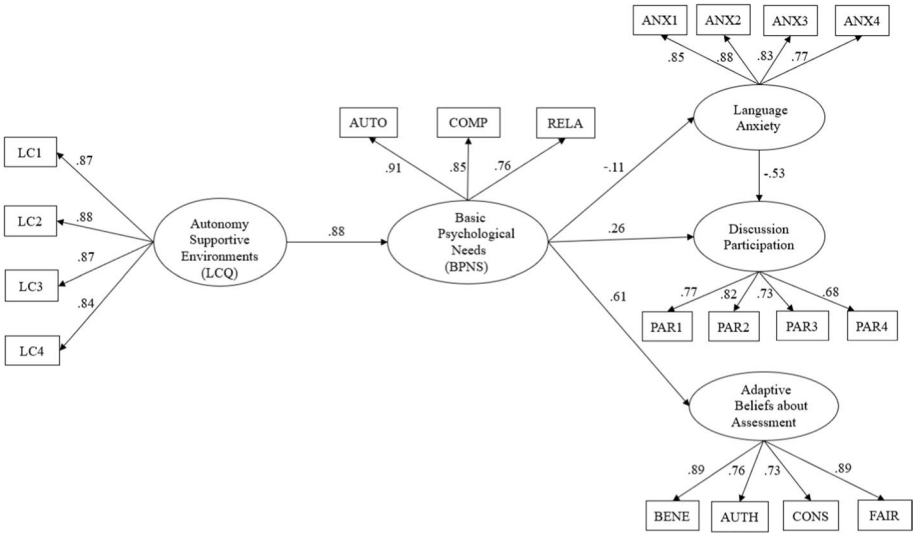

Fig. 2 Structural equation model. All solid line path coefficients are significant at $p<.05$

participation, and adaptive beliefs about assessments in the classroom. Autonomy-supportive environments satisfied students' basic psychological needs which, in turn, decreased their anxiety and increased their participation in discussion and adaptive beliefs about assessment. Furthermore, the less likely that students feel language anxiety in class, the more likely they are to participate in classroom discussion, which presumably would contributes to their adjustment to the US academic environment.

First, the findings showed that international students' perception of autonomy-supportive learning environments promotes their basic psychological needs consisting of autonomy, competence, and relatedness, which decreases students' language anxiety and promotes discussion participation and adaptive beliefs about assessment. This finding is consistent with previous findings from the SDT literature that autonomy-supportive environments are associated with a wide range of positive learning experiences, such as more engagement in schoolwork (Jang et al., 2010; Reeve, 2006; Wang, & Holcombe, 2010), deep-level learning (Vansteenkiste et al., 2004, 2012), and self-regulated learning (Sierens et al., 2009). The current study provides an additional finding that autonomy-supportive learning environments promote international students' adaptive learning behaviors. When supporting students' inner motivation and satisfying their basic psychological needs, they are more likely to feel less anxiety about their language-related ability and thus participate in classroom discussion activities, including small-group and whole-classroom discussions, which could help them to adjust to the new academic environment. This is in line with the literature and previous findings suggesting that satisfying basic psychological needs leads to positive learning outcomes and well-being (Faye & Sharp, 2008; Levesque et al., 2004; Ryan & Deci, 2000).

Additionally, when students' basic psychological needs are met, they are more likely to have adaptive perceptions regarding their assessments in the class. Assessments have a significant educational impact on students' learning. Students having adaptive perspectives about classroom assessment are significantly associated with an adaptive learning approach, learning outcomes, and self-regulatory learning (Brown, 2011; Brown, et al., 2009; Cho et al., 2020). When students recognize the beneficial aspects of assessments, authentic aspects of assessments, consistency with learning objectives, and fairness of assessments, they are more likely to use self-regulated learning strategies that lead to better learning outcomes (Cho et al., 2020). The SEM results showed that there was a significant relationship between satisfaction of basic psychological needs and adaptive beliefs about assessment. When students' needs are met, it helps them to promote more-adaptive beliefs about assessment, which could lead to a better learning approach or outcomes in the process of academic adjustment.

Based on these results, the current study provides empirical findings that SDT can explain how to promote international students' desirable learning behaviors as a theoretical framework.

Qualitative phase (RQ 2)

In the qualitative phase, the results from the quantitative study were further explored for additional explanations through follow-up semi-structured interviews with Asian international students regarding their classroom experiences. To explore which factors contribute to international students' academic adjustment, classroom experiences, and perception of autonomy support within their learning environments, a sequential explanatory

mixed-methods approach was used. In this design, an analysis of quantitative data is first conducted, followed by interview data (Creswell & Piano Clark, 2007). A follow-up semi-structured interview was used to further explore the components of students' academic adjustment and perception of autonomy-supportive environments.

Participants

Of those who participated in the survey, 24 students volunteered also to be involved in the follow-up interviews. Among those participants, the interview data from 10 students who scored high on the learning climate scale was used for the qualitative data analysis—perception of autonomy-supportive learning environment ($M = 6.11$, SD = 0.76, overall mean = 5.17, SD = 1.20). Their demographic profiles are shown in Table 2.

Data analysis

Transcribed narratives were compared to the original recordings for accuracy. Qualitative content analysis was used to identify common themes regarding students' academic adjustment and autonomy-supportive learning environments from students' experiences in the classroom. First, the meaning units were coded by open codes (labeling concepts) before categories were created by using axial codes (categorization), which represent a group of content that shares a commonality. Finally, by using selective codes (theme), the main themes involving multiple meanings were elicited.

Results for RQ2

Table 3 shows the open codes, the axial codes, and the associations of these axial codes with the thematic findings used as selective codes. The five common themes below were found from the interview data.

Theme 1: International students' most-challenging areas for academic adjustment were the presence of different learning environments and language barriers.

Nine out of ten participants stated that, in the process of adapting to the US university, it was challenging for them to get used to the different learning environments, such as those including group discussions or hands-on activities. Language barriers were another obstacle, with four participants expressing that they struggled with understanding lectures, communicating with classmates, and writing in English.

Theme 2: The most-helpful resources for international students for adapting to the US universities were instructors' additional help in addressing their academic challenges and needs as well as peer group support.

Participants indicated that the most-helpful learning source for their academic adjustment was extra help from instructors or departments. Several participants mentioned that they went to professors' offices to ask for help or attended help sessions offered by teaching assistants. They recalled that, when they came to the university, they also participated

Table 2 Demographic profiles of interview participants *(N = 10)*

Name (Pseudonym)	Gender	Age (years)	Country	Academic year	Major	Duration (years)
Aashi	Female	20	Singapore	Sophomore	Chemical engineering	6
Cheng	Female	23	China	Senior	Environmental engineering	4.5
Huang	Male	23	China	Senior	Computer & information engineering	Less than 4
Kang	Male	25	South Korea	Senior	Finance & management	7
Kim	Female	21	South Korea	Sophomore	Computer graphic technology	2
Lee	Female	21	South Korea	Freshmen	Engineering	1.5
Liu	Male	19	Taiwan	Sophomore	Communication	2
Wu	Female	19	China	Freshmen	Pre-communication	1.5
Yang	Female	21	China	Sophomore	Landscape architecture	3
Zhao	Female	20	China	Sophomore	Finance & management	1.5

Table 3 Coding and main themes

Open codes	Axial codes (categorization)	Selective codes (themes)
Different learning environments ($N=9$) −Mandatory classes −Hands-on activities −Group discussions −Distant feelings −Different ways of learning −Need to be independent	Classroom environment was different in terms of class sizes and ways to learn. Classroom tasks such as group discussions and hand-on activities were different. Students needed to be independent but sometimes feel distant.	Theme 1: International students' most-challenging areas for academic adjustment were the presence of different learning environments and language barriers.
Language barrier ($N=4$)	It was difficult to understand the lectures and communicate with classmates in English. Writing an essay in English was challenging.	
Extra help session ($N=6$) −Office hours −Learning community	Students took advantage of office hours. Students participated in different kinds of help sessions.	Theme 2: The most-helpful resources for international students for adapting to the US universities were instructors' extra help for academic challenges and needs as well as peer group support.
Friends ($N=3$) Group work ($N=2$)	Students asked for help from friends or classmates. Students benefited from group work with friends.	
Professors' attitude ($N=7$) −To treat students with respect −Feeling comfortable with any questions or asking for help −Clear instruction	Professors' attitudes made students feel comfortable in the classroom. Teaching assistants made students feel comfortable asking a question. Professors' clear instruction helped students feel comfortable in the class.	Theme 3: Instructors' openness and willingness to address international students' academic challenges and needs allowed students to feel comfortable in the learning environment, to feel able to approach instructors when they had questions, to trust their instructors, and to feel confident that they could do well in the course.
Openness to receiving questions ($N=7$) −Quick responses −Influence curriculum −Recitation	Professors responded to students' emails quickly. Professors used students' questions for classes. Students asked more questions in recitation than lectures because they hardly had a chance to ask questions in large lecture classes.	

Table 3 (continued)

Open codes	Axial codes (categorization)	Selective codes (themes)
Caring about students ($N=9$) –Valuing efforts –Being sensitive to students –Communication styles –Being flexible	Professors valued students' efforts in their academic work. Professors were sensitive to students' needs. Professors' communication style made students trust them. Professors made sure that students were learning.	
Professional knowledge ($N=4$) –Real-life experiences –Clear instruction	Professors had real-life experiences.	
Giving comments or feedback ($N=9$) –Verbal comments –Individualized feedback –Email notification –Clear instruction	Professors gave verbal comments on academic work. Professors provided individualized feedback. Professors provided clear instruction.	
Providing help sessions ($N=6$) –Preview chance –Prep tests –Making sure that students are learning –Enough supplements –Being flexible –Encouraging	Professors provided help sessions. Professors gave students preview chances before the classes. Professors provided enough supplement materials for the class. Professors made sure that students were actually learning.	
Providing options and choices ($N=8$) –Relate to your field –Independent research –Easy to do	Professors provided options in assignments according to students' interests and backgrounds.	Theme 4. Students felt that when instructors provided options and choices in classroom tasks or assignments, they could choose a task that they liked based on their interests and relate knowledge from the class to other areas in their major.
Topic familiarity ($N=6$)	Students participated in discussions that provided learning benefits and focused on familiar topics.	Theme 5. When international students felt familiar with the topics and identified the value of learning through discussions, they were more willing to participate in the discussions. They also preferred small-group discussions to the whole-classroom discussions.
Topic unfamiliarity ($N=5$)	Students did not participate in discussions when they felt unfamiliar with the topic and had nothing to say.	
Small-group discussion preference ($N=7$) –Feeling comfortable to talk –Valuing learning benefits	Students preferred small-group discussions. because they felt more comfortable talking to peers and learned better than in large classroom discussions.	

in different types of help sessions that their department provided for freshmen. Students were able to benefit from individual extra help to catch up with classes and ask questions to support their learning. They found that extra help was the most-useful resource when they attempted to adapt to the university.

Theme 3: Instructors' openness and willingness to address international students' academic challenges and needs allowed students to feel comfortable in the learning environment, to feel able to approach instructors when they had questions, to trust their instructors, and to feel confident that they could do well in the course.

When participants were asked about whether they felt comfortable in the classroom environments, seven out of ten students stated that instructors' openness and respect made them feel comfortable in the learning environment. They claimed that, when instructors approached students with openness and respect, students were more likely to feel comfortable in the learning environment and engage in classroom activities. For example, Kim mentioned that he felt that his class was an accepting environment because students were invited to speak about their opinions in small groups. Kang also stated that his instructor allowed anyone to speak and ask any questions that they had.

Theme 4: Students felt that, when instructors provided options and choices in classroom tasks or assignments, they could choose a task that they liked based on their interests and relate knowledge from the class to other areas in their major.

Eight participants mentioned that they had options or choices in their classroom tasks or assignments, and that they could choose a topic based on what they perceived as interesting and relevant. When they had these options, they felt that the classroom tasks were quite flexible and that they could do them easily.

Theme 5: When international students felt familiar with the topics and identified the value of learning through discussions, they were more willing to participate in discussions. They also preferred small-group discussions to the whole-classroom discussions.

If international students face difficulty with language and unfamiliarity with classroom discussions, they are less likely to participate in the classroom. Participants were asked if they would be willing to participate in classroom discussions when there was no incentive or extra credit for doing so. Six participants mentioned that they were willing to participate in discussions when they valued the benefit of discussions to improve their learning or when they felt familiar with the topic. These students pointed out that extra credit did not matter for their participation. As long as they found some learning benefit from discussions, they said that they would be willing to participate in them.

Discussion for qualitative phase

Instructors' openness and willingness to address international students' academic challenges

The most-challenging aspects for international students' academic adjustment were the differences in learning environments between the USA and their home countries and language barriers. On the other hand, the most-useful resources for international students when adapting to US universities were instructors' additional help to meet students' needs when they faced academic challenges, as well as support from their peer group. Overall, participants' responses to learning climates suggested that the way in which instructors treat students and give instruction might determine students' perception of the extent to which environments are autonomy supportive. A key finding of this study is that instructors' openness and willingness to address international students' academic challenges and needs enable students to feel comfortable in learning environments, to approach instructors when they have questions, to trust their instructors, and to feel confident in their ability to do well in the course. Instructors' willingness to create environments that meet the basic psychological needs of autonomy, competence, and relatedness bolster students' adjustment to the novel academic environments experienced in the USA. That is, instructors' willingness to respond to students' academic needs can satisfy students' need for autonomy in the course, give them confidence in classroom tasks, and enable them to feel connected to others in classes. Although international students experience academic challenges during the transition, when they receive autonomy support, they use these opportunities to develop new learning strategies to handle these challenges (Wu et al., 2015). In this way, instructors' attitudes toward students help them to adjust to new learning environments at US universities.

Previous research has also recognized the crucial role of instructors in international students' academic achievement (Jackson et al., 2013). When international students encounter academic challenges, faculty can help them by being responsive to their academic needs. Interaction with faculty often contributes to greater academic achievement among international students (Anaya & Cole, 2001). Furthermore, this finding is aligned with the previous finding in the SDT literature suggesting that, when instructors show more empathy by taking students' perspective and by identifying students' difficulties, such learning environments tend to lead to desirable learning outcomes (Reeve & Jang, 2006). Moreover, by fostering students' needs, instructors can contribute to students' internalization process and eventually bolster their intrinsic motivation (Ryan & Deci, 2008). Instructors' attitudes and willingness to support students encountering academic challenges foster the satisfaction of students' basic needs for autonomy, competence, and relatedness, which help them to adjust to new learning environments in the US universities.

Creating autonomy-supportive learning environments and constructing discussion tasks around students' interests and perceived relevance

The qualitative findings suggest that designing autonomy-supportive learning environments and constructing discussion tasks around topics that students perceive as interesting and relevant promote students' participation in classroom activities. Discussion is used as an instructional strategy to enliven classroom life and help students to engage in classroom activities and reach deeper understanding (Parker & Hess, 2001). However, based

on international students' experiences, the topics that instructors propose and the types of learning environments that are created for students seem to determine the quality of classroom discussions. As participants suggested in the interviews, as long as they could relate to the topics and found benefits in the discussions, students were willing to participate in classroom discussions, even in the absence of external rewards or reinforcements. This finding is aligned with the assertion that autonomy-supportive environments support students' internalization (Ryan & Deci, 2017). The more that students perceive classroom discussions as relevant and the greater they value these discussions, the more likely they are to participate in those discussions. These types of discussions create favorable learning environments that provide opportunities for students to identify benefits for learning in discussion activities. Such learning environments provide opportunities for students to integrate themselves into a new academic learning community and potentially, in some cases, to find intrinsic motivation toward learning.

In sum, the qualitative findings suggest that basic psychological needs theory and the autonomy-supportive model in SDT can provide a solid theoretical framework to support these qualitative findings.

General discussion

Autonomy-supportive learning environments

Autonomy-supportive learning environments are associated with the satisfaction of students' basic psychological needs which, in turn, is associated with a decrease in anxiety and an increase in participation in discussions and adaptive beliefs about assessment. The findings highlight the importance of creating more autonomy-, competence- and relatedness-supportive learning environments by being open and willing to respond to students' academic challenges and needs. How students adjust themselves to a new academic environment depends not only on students as individuals but also on students' social contexts, such as learning environments (Poyrazli & Grahame, 2007). The results of the current study are aligned with previous findings from SDT research suggesting that autonomy-supportive learning environments fulfill students' fundamental basic psychological needs and then lead to desirable learning outcomes and behaviors (Deci, Koestner, et al., 2001; Deci, Ryan, et al., 2001; Hofferber et al., 2016; Jang et al., 2009; Reeve, 2006; Vallerand et al., 1997; Wang et al., 2016). Furthermore, overall, participants' responses regarding their perception of the learning environment in the semi-structured interviews supported these results from the quantitative data. The main finding is that instructors' openness and willingness to address international students' academic challenges and needs made students feel comfortable, trust in their instructors, and feel greater confidence in their ability to do well in the course. It appears that instructors' openness and willingness to address international students' needs tend to fulfill these students' basic psychological needs of autonomy, competence, and relatedness, which then encourages them to participate in classroom activities and ultimately helps them to adjust to new learning environments. Support from instructors was crucial for these students to succeed academically (Mamiseishvili, 2012). The current findings from both the quantitative and qualitative studies on international students' academic adjustment add to the empirical evidence that supports the importance of basic psychological needs satisfaction and autonomy-supportive learning environments.

In addition, well-structured instruction is a crucial element for international students' academic adjustment. Autonomy-supportive learning environments do not provide unlimited freedom and choices; these environments have structure (Reeve, 2006; Vansteenkiste et al., 2012). The findings from the qualitative phase of the study support this assertion. When instructors provided clear guidelines and instruction in class, students felt comfortable and confident that they could do well in the learning environments. In particular, students were more likely to participate in classroom discussions when they could identify the learning benefits and the relevance of the topic to their background knowledge or interests. This implies that, in creating autonomy-supportive learning environments, instruction with well-structured classroom tasks (e.g., discussions) around students' interests and areas of familiarity are as important as instructors' openness and willingness to make students feel comfortable and able to follow the classes, which eventually influences students' academic adjustment. Structure is another important concept in creating autonomy-supportive environments (Deci & Ryan, 2016; Jang et al., 2010). Communicating with students using clear expectations is a crucial characteristic of structure. Instructors' autonomy-supportive instruction and clear expectations seem to work together to increase positive school functioning by decreasing students' anxiety (Jang et al., 2010; Vansteenkiste et al., 2012). Thus, instructors should create well-structured environments in which students feel comfortable and confident in their ability to complete classroom tasks well.

The present study adds to the literature in two ways. First, from a theoretical perspective, SDT can be expanded as a conceptual framework to explain international students' academic performance and adjustment. We proposed that autonomy-supportive environments would make international students' academic experiences more successful by supporting their needs for autonomy, competence, and relatedness. This empirical study provides a more-concrete picture of how Asian international students' perception of autonomy-supportive contexts and basic psychological needs satisfaction are associated with their affective, behavioral, and cognitive learning components. This study reveals that SDT provides a comprehensive theoretical framework to elucidate international students' successful classroom learning experiences regarding communication and adjustment. The current study emphasizes why autonomy-supportive learning environments are important for Asian international students' academic adjustment by showing the relationship with various learning variables and by capturing students' vivid perspective of their learning experiences. The qualitative data enabled us to deeply explore various aspects of learning components that influence international students' perception of an autonomy-supportive environment and academic adjustment at the individual level.

Assessment practice to include culturally- and linguistically-diverse students

Within SDT, when students perform poorly in assessments, assessments such as high-stakes assessments can cause them to be controlled motivated or amotivated (Ryan & Deci, 2017; Ryan & Weinstein, 2009). Assessment focusing on outcomes often brings about controlling tensions and fails to promote process-focused instruction (Deci, Koestner, et al., 2001; Deci, Ryan, et al., 2001; Ryan & Deci, 2017). This study yields insightful implications for classroom assessment practice for culturally-and linguistically-diverse students as classrooms are becoming more diverse in higher education.

Considering cultural and learning contexts is important for understanding the complexity of student learning (Zhu et al., 2008). There is a need for a cultural understanding of students' various cultural differences that impact instructors' teaching, and instructors'

teaching and assessment practices should be considered as being culturally responsive (Hodkinson & Poropat, 2014; Nortvedt et al., 2020). Instructors' inclusive assessment practice considering culturally- and linguistically-diverse students contributes to creating an adaptive learning environment where diverse students benefit and learn better (Kaur et al., 2017). It is crucial for designing adaptive and inclusive assessment methods.

Inclusive assessment can be a new standard for evaluating students' understanding (Carjuzaa & Ruff, 2010). When instructors design inclusive assessment, they are mindful of the language used for diverse student populations and they consider cultural differences in the development of the assessment (Montenegro & Jankowski, 2017). They consider assessment validity and reliability in light of students' cultural understanding and tailor their assessment practices and materials (Montenegro & Jankowski, 2017; Nortvedt et al., 2020; Qualls, 1998). Inclusive assessment designs can promote equitable learning outcomes and complement high-stakes standard achievement tests (Cuseo, 2015; Zimmerman et al., 2020). Developing a culturally-responsive and -inclusive assessment would contribute to enhancing students' learning experience, especially for those from culturally- and linguistically-diverse backgrounds.

Limitations and suggestions for future studies

The present study had a couple of limitations. First, it was not conducted in one specific course. For the quantitative survey, students were asked to choose one class in their major that they perceived to be most important. Students responded to all survey items and interview questions in reference to that course. Their perceptions of the learning climates and their learning experiences can vary by subject and instructor, but this study was unable to exclude these effects.

In addition, this study did not include enough participants to represent each academic year level. It would be beneficial in future studies to perform analyses specifically based on different durations of time that students spent in the USA. Depending on the duration of time spent in the USA (e.g., less than 1 year versus 3–5 years) or students' academic year, there might be some variance in the extent of their academic adjustment. Further study with larger sample sizes across academic year levels would be useful for examining other factors in international students' academic adjustment.

This study also used only Asian international students' responses. If future studies are able to extend the sample to a broader group of international students, such as African, Latino, or European students, it would be possible to examine more explicitly the hypothesized model to identify factors that influence overall international students' adjustment in an academic environment. Furthermore, future research should include data from domestic students to investigate differences in the hypothesized model between mainstream and culturally-diverse populations.

Finally, when investigating international students' academic adjustment, future research could benefit from including classroom observations or interviews with course instructors in order to triangulate findings from surveys or interview data from students' perspectives. Instructors' classroom observations or a longitudinal design to explore how this phenomenon has changed over time would complement the current cross-sectional design.

Conclusion

The current findings suggest that autonomy-supportive environments satisfy Asian international students' basic psychological needs and promote their desirable learning behaviors. This study also provides a strong rationale for creating a learning environment that satisfies international students' basic psychological needs so that they can adapt to US academic learning environments. The current results contribute to the literature by suggesting a theoretical foundation for facilitating successful academic adjustment among Asian international students.

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